HVAC Learning.com

Exercise Booklet

Print this exercise booklet before studying the lesson on-line. It will enable you to write your answers to the HVAC learning exercises. You will thus be able to switch between reading or listening to the file on-line and writing in the booklet.

POWER IN HVAC

English lesson:
https://hvac-learning.com/base-physics/physics-level-2/power-in-hvac/

French lesson:
https://formation.xpair.com/cours/puissances-genie-climatique.htm

For each exercise, you will write your answer, then you will study its correction on-line before going to the next exercise.
If you cannot do an exercise, you will be able to study its correction directly, but ***force yourself to write your answer*** *as often as possible.*

Note that between 2 exercises, you will find it necessary to study the course. As a warning, in the booklet, you will sometimes find the following indication:

- *"* ***Study the course on-line before doing the next exercise****" or*
- *"* ***Study the course on-line before going to the next paragraph****"*

Only study the paragraphs or the exercises which have an equal or a lower level than the one your training requires.
NVQ Level = Vocational Certificate
A Level = High school Diploma
HND Level = Associate's Degree
MSC Level = Engineering Schools

Then, when you have completed a file, you will be able to assess your level on-line through a Multiple Choice Questionnaire in which you will only answer the questions related to the themes you have studied.
So now off you go and work well!
Good luck!
The Authors.

N°1 – Power training – NVQ level

Study the course on-line.

N°2 – Units of power and energy supply training – A to HND Level

Study the course on-line.

Q = P x t
With
Q in joule,
P in watts,
t in seconde

N°3 – The Kilowatt-hour training – NVQ to A level

Study the course on-line before treating the next exercise.

1 [kWh] = 3,600 [kJ] = 3,412 Btu

Q = P x t
With:
– Q in [kWh];
– P in [kW];
– t in [h]

Question 1

An apartment has 8 light bulbs of 60 watts. If the lighting is used on average 2 [h/day], calculate the annual lighting consumption in [kWh].
What would have been the consumption if we had indicated the value in [kJ]?
For a unit price of about 0.15 [€/kWh], what is the annual lighting cost for this apartment?

Question 2

An apartment has 5 electric convector heaters of 1,500 watts.
If these convectors are used on average 8 [h/day] during the 230 days of the heating season, calculate the electrical consumption of this heating appliance in [kWh].
For a unit price of 0.15 [€/kWh], what is the annual cost for heating this apartment?

N.B.:

- *[MWh] corresponds to 1,000 [kWh]*
- *We also sometimes use the watt-hour ([Wh]) defined as the use of 1 watt of power during 1 hour.*
  Obviously, the [Wh] = 1 / 1,000 [kWh] = 3,600 joules

N°4 – Study of the relation power/energy – A level

Study the course on-line before treating the next exercise.

- Knowing the power and its time of use enables us to calculate the quantity of energy supplied (or consumed):
  Q = **P x t**
- Knowing the quantity of energy to be supplied and the time available, enables us to calculate the power required:
  P = **Q / t**
- Knowing the quantity of energy to be supplied, and the power available, enables us to calculate the duration of the operation:
  t = **Q / P**

Question 1

The heating of a container requires a supply of 15 000 [kWh] (51 182 124 Btu).
The time available to bring the temperature to its required level is 6 [h].
What in [kW] will be the power needed to achieve this ?

Question 2

To remove a quantity of heat of 37 500 [kWh] (127 955 311 Btu) from a container, we have a cooler with a refrigerating capacity of 13 [kW].
How much time would be necessary to perform this operation?

Question 3

The power of a boiler in an apartment block is 250 [kW].
For heating and the production of domestic hot water, it is used 24/24, at an average of 20% of its maximum capacity.
What quantity of heat in [MWh] is supplied each year?

Question 4

To supply a tank with a quantity of heat of 37 500 [MJ] (35 543 142 Btu), we have a boiler with a power of 250 [kW].
How much time is required to perform this operation?

N°5 – Formulae Q = MC ΔT and P = Q/T training – Part 1 – A to HND level

Study the course on-line before treating the next exercise.

Q =**M** x **C** x**ΔT**
With:
Q: Quantity of heat in [kJ]
M: Mass involved in [kg]
C: Specific heat in [kJ/kg.K]
ΔT: range of temperature gain (or loss).

Question 1

Knowing that the specific heat of water is 4.18 [kJ/kg.K] (3.96 Btu/kg.K), determine in [kWh] the quantity of heat necessary to heat a water tank of 200 litres from 10 to 55 [°C].
Knowing that this heating operation is to take 2 hours, what power (in [kW]) will be required?

Question 2

What power would be required to heat 200 liters of water from 10 to 55 [°C] in 4 [h]?

Question 3

What power is required to heat from 5 to 15 [°C] in 24 [h], 15 [m3] of domestic fuel with a density of 950 [kg/m3] and a specific heat of 2.1 [kJ/kg.K] (1.99 Btu/kg.K)?

Question 4

A domestic hot water tank of 200 liters is equipped with a heating element of 1,500 [W].
How much time will it take to raise the temperature from 10 to 55 [°C] ?

N°6 – Formulae Q = MC ΔT and P = Q/T training – Part 2 – A to HND level

Question 1

We need to cool down a tank of 2,000 liters of water from 40 to 15 [°C].
We have a cooler with a refrigerating capacity of 13 [kW].
How long will it take to perform this operation?

Question 2

Knowing that the specific heat of steel is approx. 0.5 [kJ/kg.K], what mass of steel can be heated from 5 to 70 [°C] in 1 [h] with a heating element of 2.5 [kW]?

Question 3

We need to cool down a 60 [m^3] tank of ethanol from 55 to 25 [°C].
The density of ethanol is 800 [kg/m^3] and its specific heat is 2.45 [kJ/kg.K].
This operation must be performed in 8 [h].
What cooling capacity will be necessary?

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